CHEMISTRY 16
LABORATORY FINAL EXAM

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August 4, 1998

An optical scoring machine will grade this examination. The machine is not programmed to accept the correct one of two sensed answers and will not sense answers which are lightly marked. Mark your answer sheet carefully with a No. 2 soft lead pencil and erase any undesired marks COMPLETELY. Avoid making any extraneous marks on the answer sheet other than information asked below.

On the answer sheet:

1. Print your name in the space for NAME (Last name first, circle your last name).

2. In the space marked SUBJECT print your student number.

3. In the space marked HOUR, write Summer II '98.

4. Check to see that you have 20 examination questions, periodic table, scratch paper and an answer sheet.

HAND IN ONLY THE ANSWER SHEET.

SCORE = _____%

Backtest from Summer II 1998

LAB FINAL EXAM

1. The percent ionization of 0.600 M NH_3 is:
$K_B(NH_3)=1.8\times10^{-5}$

A. 3.3%
B. 0.25%
C. 11%
(D.) 0.55%
E. 6.0%

2. As solid sodium sulfide (Na_2S) is added to a 0.075 M solution of the weak acid H_2S, the concentration of H_2S will _____ while the pH will _____.
(HINT: Write both acid equilibria for H_2S)

(A.) increase; increase
B. increase; decrease
C. decrease; decrease
D. decrease; increase
E. remain the same; decrease

3. In Experiment #5, a precipitate of $Mg(OH)_2$ was formed by reaction of $Mg(NO_3)_2$ with aqueous ammonia. The equilibria established are shown below.

$$NH_3(aq) + H_2O \leftrightarrow NH_4^+(aq) + OH^-(aq)$$
$$Mg^{+2}(aq) + 2\ OH^-(aq) \leftrightarrow Mg(OH)_2(s)$$

Addition of which of the following to an equilibrium mixture will cause some of the solid $Mg(OH)_2$ to dissolve?

A. $MgCl_2$
B. KCl
(C.) NH_4Cl
D. NaOH
E. None of the above. All will cause more $Mg(OH)_2$ to precipitate except the KCl.

4. Which of the following salts hydrolyzes in water to give a basic solution?

A. $Al_2(SO_4)_3$
B. KBr
C. NH_4NO_3
(D) K_2CO_3
E. $Ca(ClO_4)_2$

5. Which of the following will cause a decrease in the rate of the reaction below (as evidenced by rate of formation of hydrogen gas)?

$$Zn(s) + 2\,H^{+}(aq) \rightarrow Zn^{+2}(aq) + H_2(g)$$

A. Use powdered zinc instead of large pieces.
B. Use of magnesium instead of zinc.
C. Change in reaction temperature from room temperature to 55°C.
D. Use of 5.0 M HCl instead of 0.5 M HCl
E. Use of acetic acid instead of hydrochloric acid.

6. An aqueous solution of an unknown solid salt was placed into five different test tubes. Into each of the test tubes was placed a couple of drops of the different indicators shown below and the color of the indicator in the unknown solution was recorded. The approximate pH of the unknown salt solution is _____ and the unknown salt could be _____.

Indicator	pH Range	Acid Color	Base Color	Color in Unknown Soln
2,4 Dinitrophenol	2.8-4.0	Colorless	Yellow	Yellow
Lacmoid	4.4-6.2	Red	Blue	Blue
Phenol Red	6.6-8.0	Yellow	Red	Yellow
Thymol Blue	8.0-9.6	Red	Yellow	Red
Thymolphthalein	9.4-10.6	Colorless	Blue	Colorless

A. 7; KNO_3
B. 9; Na_2CO_3
C. 9; $NaC_2H_3O_2$
D. 5; $AlCl_3$
E. 7; KNO_2

7. Which of the salts given below are INSOLUBLE in water?

Li_3PO_4 $FeSO_4$ Hg_2I_2 $CaCO_3$ $AlCl_3$

A. All but Li_3PO_4
B. $FeSO_4$ and $CaCO_3$
C. Hg_2I_2 and $CaCO_3$
D. Hg_2I_2 only
E. $AlCl_3$, $FeSO_4$ and Hg_2I_2

8. If 12 g of $Hg(NO_3)_2$ is dissolved in enough water to make 750. mL of a solution, the molarity of Hg^{-2} in the resulting solution is:

A. 0.016 M
B. 0.049 M
C. 0.36 M
D. 1.79 M
E. 0.098 M

9. When bismuth (III) nitrate is reacted with aqueous H_2S, a white precipitate is formed. Predict products and write the net ionic equation for this reaction. The spectator ions are:

A. NO_3^- only
B. Bi^{+3} and S^{-2}
C. Bi^{+3} and NO_3^-
D. There are no spectator ions. All ions appear in the net ionic equation.
E. H^+ and NO_3^-

10. Both Al^{+3} and Zn^{+2} form amphoteric hydroxides while only Zn^{+2} forms an ammonia complex. The reagent _____ can be used to separate solid $Al(OH)_3$ from solid $Zn(OH)_2$ because _____.

A. HCl; only the $Zn(OH)_2$ will dissolve.
B. H_2O; more $Al(OH)_3$ will precipitate.
C. NH_3; the $Zn(OH)_2$ will dissolve.
D. NaOH; the $Zn(OH)_2$ will dissolve.
E. There is no reagent that can be added to separate the two hydroxides.

11. A concentrated solution of a student's unknown solid salt was **colorless**. Of the cations below, a complete list of all the metal cations that **could be** present is:
(HINT: Consider the electronic configuration)

V^{+3} Zn^{+2} Pb^{+2} Co^{+2} K^+

A. K^+ only
B. Zn^{+2}, Pb^{+2}, and K^+
C. V^{+3} and Co^{+2}
D. V^{+3}, Pb^{+2} and Co^{+2}
E. All could be present but Co^{+2}.

12. The best way to test for the presence of the **sodium cation** in an unknown solid salt is to:

A. Add HCl to a solution of the salt and precipitate NaCl.
B. Dissolve the unknown salt in water. If soluble then Na^+ is present.
C. Flame test an aqueous solution of the unknown salt. An intense orange flame indicates Na^+ is present.
D. Add H_2S at pH>8 to a solution of the salt and precipitate Na_2S.
E. None of the above. There is no way to positively identify the presence of Na^+.

13. The conditions used to precipitate Mn^{+2} in Group III are 0.10 M H_2S in a 2.0M NH_3/0.10M NH_4^+ buffer. The concentration of Mn^{+2}still remaining in solution under these conditions is:
(HINT: Calculate $[H_3O^+]$ present due to the NH_3/NH_4^+ buffer first)
$K_b(NH_3)=1.8\times10^{-5}$

$$MnS(s) + 2\ H_3O^+(aq) \rightarrow 2\ H_2O + H_2S(aq) + Mn^{+2}(aq) \qquad K_{spA}=1.2\times10^{7}$$

A. 3.8×10^{-4} M
B. 8.5×10^{-6} M
C. 9.1×10^{-14} M
D. 7.6×10^{-10} M
E. 4.5×10^{-9} M

14. The Group IV metal cations (Ba^{+2}, Sr^{+2} and Ca^{+2}) can be separated from the Group V metal cations (Na^+, K^+, NH_4^+ and Mg^{+2}) by addition of _____.

A. HCl
B. H_2O
C. H_2S in acidic solution
D. $(NH_4)_2CO_3$ in basic solution
E. H_2S in basic solution.

15. Two adjacent Chem 16 students were analyzing for the anion of an unknown salt. The possible anions were NO_2^-, NO_3^-, CO_3^{-2}, SO_3^{-2} and SO_4^{-2}. Each student tested the solid with concentrated H_2SO_4 and a solution of their unknown salt with $BaCl_2$(aq) and acidified $KMnO_4$. Their observations are recorded below. The anion present in Student A's unknown was _____ while that in Student B's was _____.

	H_2SO_4	$BaCl_2$(aq)	acidified $KMnO_4$
Student A:	colorless gas	white ppt.	Color change purple→pink
Student B:	colorless gas	white ppt.	No color change

A. NO_2^- ; SO_4^{-2}
(B.) SO_3^{-2}; CO_3^{-2}
C. CO_3^{-2}; SO_4^{-2}
~~D. SO_3^{-2}; CO_3^{-2}~~
E. NO_3^-, SO_3^{-2}

16. Consider the system at equilibrium below

$$Sb^{+3}(aq) + 3\,H_2O \leftrightarrow 2\,H_3O^+(aq) + SbOCl(s)$$

Which of the following stresses will cause some of the solid SbOCl to dissolve?

A. Removal of half of the solid SbOCl.
B. Addition of NaOH.
C. Addition of $Sb(NO_3)_3$.
(D.) Addition of HNO_3.
E. Addition of NaCl.

17. A 50.0 mL sample of 0.10 M HA (a weak acid) was titrated with 0.10 M NaOH. The pH of the solution halfway to the equivalence point (after the addition of 25.0 mL of NaOH) was 4.62. The value of K_A for the weak acid HA is:

A. 4.6×10^{-6}
(B.) 2.4×10^{-5}
C. 4.2×10^{-10}
D. 1.0×10^{-7}
E. 3.7×10^{-3}

18. An aqueous solution of $Ba(OH)_2$ is often used as a reagent in chemistry lab. The molar solubility of $Ba(OH)_2$ in water is:
$K_{sp}(Ba(OH)_2)=5.0\times10^{-3}$

A. 0.035 M
B. 0.0012 M
C. 0.11 M
D. 0.010 M
E. $Ba(OH)_2$ is considered to be soluble and its solubility in water is infinite.

19. Precipitation of an ionic compound will occur upon mixing of desired reagents if the initial ion product is _____.

A. equal to K_{sp}
B. less than K_{sp}
C. equal to pK_{sp}
D. greater than zero.
E. greater than K_{sp}

20. An unknown solid salt had the following properties:

I. Soluble in water.
II. Negative results on a flame test (no color observed in flame)
III. Light pink when dissolved in solution.
IV. No precipitate on addition of HCl or H_2S in acidic solution.
V. Precipitate on addition of H_2S in basic solution.
VI. No reaction with H_2SO_4 or $KMnO_4$.
VII. A solution of the unknown solid gave a white precipitate with addition of $AgNO_3(aq)$ and also upon additon of $BaCl_2(aq)$.

The unknown solid could be which of the following:

A. $Mn_3(PO_4)_2$
B. $BaSO_3$
C. Na_2SO_4
D. $(NH_4)_2CO_3$
E. $MnSO_4$